PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G01J 5/16	A1	(11) International Publication Number: WO 99/01726 (43) International Publication Date: 14 January 1999 (14.01.99)

(21) International Application Number: PCT/IB98/00759

(22) International Filing Date: 18 May 1998 (18.05.98)

(30) Priority Data:
97202056.4 3 July 1997 (03.07.97) EP
(34) Countries for which the regional or international application was filed: NL et al.

(71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(71) Applicant *(for SE only)*: PHILIPS AB [SE/SE]; Kottbygatan 7, Kista, S-164 85 Stockholm (SE).

(72) Inventors: LAST, Frits; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). BREMER, Petrus, Johannes; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). LULOFS, Klaas, Jacob; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). VAN DER WAL, Roelf; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

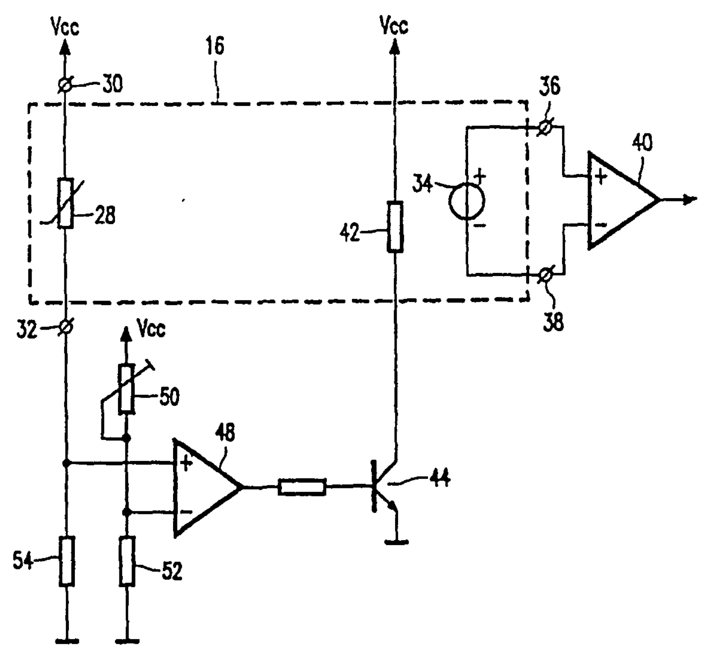
(74) Agent: HESSELMANN, Gerardus, J., M.; Internationaal Octrooibureau B.V., P.O. Box 220, NL-5600 AE Eindhoven (NL).

(81) Designated States: CN, JP, SG, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: DEVICE FOR MEASURING THE TEMPERATURE OF AN OBJECT BY MEANS OF A THERMOCOUPLE INFRARED SENSOR, AND THERMAL ELECTRICAL APPLIANCE INCLUDING SUCH A DEVICE

(57) Abstract



During measurement of infrared radiation by means of an infrared sensor (16) based on a thermopile (34), for example in hair dryers, a voltage is generated which is proportional to the temperature difference between the cold junction and the hot junction of the thermopile (16). The hot junction is exposed to infrared radiation from an object whose temperature is monitored or measured. The temperature of the cold junction is measured by means of a junction temperature sensor (28) accommodated in the infrared sensor (16). The voltage of the thermopile (34) is subject to tolerances and not accurate, as a result of which the calculation of the temperature of the hot junction is also inaccurate. By heating the cold junction to an adjustable reference temperature by means of a heating element (42) it is possible to detect whether the hot junction has a temperature equal to the reference temperature on the basis of a zero signal voltage from the thermopile (34). It is also possible to heat the cold junction until the temperature of the cold junction is equal to that of the hot junction, which can be detected accurately in that the signal voltage of the thermopile (34) becomes zero. Both junctions then have a temperature indicated by the built-in junction temperature sensor (28).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

Device for measuring the temperature of an object by means of a thermocouple infrared sensor, and thermal electrical appliance including such a device.

The invention relates to a device for measuring the temperature of an object, which device comprises: an infrared sensor, which infrared sensor comprises a thermocouple having a first junction, which is exposed to infrared radiation emanating from the object in operation, and a second junction, which is at a reference temperature in operation, and a junction temperature sensor for measuring the temperature of the second junction.

The invention also relates to a thermal electrical appliance comprising electric heating means for heating an object, an infrared sensor for measuring the temperature of the object, and control means for controlling the heat output of the electric heating mean in response to a signal from the infrared sensor, the infrared sensor comprising a thermocouple having a first junction, which is exposed to infrared radiation emanating from the object in operation, and a second junction, which is at a reference temperature in operation, and a junction temperature sensor for measuring the temperature of the second junction.

Such a device and such a thermal appliance are known from, inter alia,. UK Patent Application GB-A-2 093 343, which discloses a hair dryer having an infrared sensor which measures the temperature of the hair to be dried. For this purpose the infrared sensor is mounted on the housing of the hair dryer and an optical system focuses the infrared radiation from the hair onto the infrared sensor, which generates a signal which is proportional to the received infrared radiation and is consequently a measure of the temperature of the hair. The signal is used for controlling the heat output of the heating element of the hair dryer so as to preclude overheating of the hair and burning of the scalp. The infrared sensor mentioned in said Patent Application is a so-called thermopile, which comprises a plurality of thermopiles arranged in series. A thermocouple, whose operation is taken to be known per se, supplies a voltage which is proportional to the temperature difference between the so-called cold junction and hot junction of the thermocouple. The hot junction is heated by direct or indirect heat transfer from the object whose temperature is to be measured. In said hair dryer the hot junction is exposed to infrared light emanating from the hair to be dried. The cold junction is not exposed to radiation and is at a reference

temperature, which is generally equal to the ambient temperature. The thermocouple supplies a signal voltage whose magnitude is proportional to the temperature difference between the cold junction and hot junction. In order to be able to determine the temperature of the object it is therefore necessary to know the temperature of the cold junction. For this purpose, use is made of a junction temperature sensor by means of which the temperature of the cold junction can be measured. Thermopiles having a built-in junction temperature sensor are commercially available.

A drawback of the known device and the known appliance is that the accuracy of the measurement of the temperature of the hair is not very high. This is caused inter alia by tolerances in the construction and the sensitivity of the thermopile sensor itself but also by the degree in which the infrared radiation is generated in the hair and the manner in which the infrared radiation is focused on the sensor. There is a fairly large tolerance on the signal voltage of the thermocouple or the thermopile for a given quantity of infrared radiation. Such a problem occurs in other thermal electrical appliances using infrared temperature measurement, such as toasters, ovens, cooktops, irons, radiant heaters, which heat an object or a space and which measure the temperature of the object or space by means of an infrared sensor. The problem also occurs in the case of a direct temperature measurement based on infrared measurement by means of a thermocouple or thermopile, for example in a clinical thermometer which determines the body temperature on the basis of infrared radiation emanating from the tympanic membrane of a person.

It is an object of the invention to solve this problem. To this end, the device and the thermal electrical appliance of the type defined in the opening paragraphs are characterized in that the device further comprises: junction heating means for heating the second junction to a predetermined temperature.

The junction heating means enable the cold junction to be heated until the temperature difference between the hot junction and the cold junction is zero. Under these conditions the signal voltage generated by the thermocouple or the thermopile is substantially zero. The cold junction temperature which is then measured by means of the junction temperature sensor corresponds to the hot junction temperature and is now a measure of the temperature of the object. The tolerance in the generated signal voltage now does not play a role.

In thermal electrical appliances in which an object is heated by hot air it is favourable to heat the cold junction to a temperature which corresponds to the desired temperature of the object to be heated. The output signal of the thermocouple becomes zero

as soon as the hot junction has reached the same temperature as the cold junction as a result of the infrared radiation from the object. When the output signal becomes zero this indicates that the object has reached the desired temperature and that the hot air can be turned off. The thermocouple sensor does not produce an error when the temperatures of the hot junction and the cold junction are equal. As long as the temperatures of the hot junction and the cold junction are not yet equal there is merely an error in the gain of the control system.

The junction heating means for heating the cold junction can be constructed in various ways. This is possible by means of a special heating resistor which, for this purpose, is accommodated in the body which also accommodates the thermocouple or thermopile, or by means of a heating resistor or heating wire which heats the cold junction from the outside. If the junction temperature sensor is a temperature dependent resistor which is thermally coupled to the cold junction, it is also possible to use the temperature dependent resistor for heating the cold junction. A proper thermal coupling between the temperature dependent resistor and the cold junction provides a short response time. A further alternative is the use of the thermocouple itself as a junction heating means, which enables an even faster response to be achieved. In both cases heating of the cold junction can be effected during only a part of the available time because the temperature dependent resistor or the thermocouple have a double function.

These and other aspects of the invention will be described and elucidated with reference to the accompanying drawings, in which:

Figure 1 shows a hair dryer with an infrared sensor;

Figure 2 is a sectional view of an infrared sensor;

Figure 3 is a plan view of an infrared sensor;

Figure 4 shows a first circuit diagram of an electronic circuit for use in a device for temperature measurement in accordance with the invention;

Figure 5 shows a second circuit diagram of an electronic circuit for use in a device for temperature measurement in accordance with the invention;

Figure 6 shows a third circuit diagram of an electronic circuit for use in a device for temperature measurement in accordance with the invention;

Figure 7 shows a fourth circuit diagram of an electronic circuit for use in a device for temperature measurement in accordance with the invention.

In these Figures parts having a similar function or purpose bear the same reference signs.

Figure 1 shows a hair dryer 2 which comprises a housing 4 having an air inlet opening 6 and an outlet opening 8, between which an electrical heating element 10 is arranged to heat the air which is drawn in through the air inlet opening 6 by a motor-driven fan 12 and which is expelled through the outlet opening 8. In operation the user aims the outlet opening 8 at the hair 14 of the scalp in order to dry the hair. The temperature of the hair is measured by means of an infrared sensor 16, which is mounted, for example, in the center of the outlet opening 8. However, mounting at the circumference of the outlet opening 8 is also possible. The infrared sensor 16 is electrically coupled to control means 18 which control the heat output of the electrical heating element 10 in dependence upon the measured hair temperature. When a given hair temperature is reached the control means 18 reduce or stop the supply of heat by the heating element 10 and/or change the speed of the fan 12 in order to preclude overheating of the hair 14 or burning of the scalp of the user.

Figure 2 is a sectional view and Figure 3 is a plan view of the infrared sensor 16. The sensor includes one thermocouple or a plurality of series-connected thermocouples, each comprising a hot junction 20 and a cold junction 22. A group of thermocouples connected in series is referred to as a thermopile. Only one pair of junctions is shown. The hot junction 20 is exposed to infrared light IR and is accommodated in a zone 24 made of a material having a low thermal capacity and a high thermal resistance. The cold junction 22 is arranged in a zone 26 made of a material having a high thermal capacity and a low thermal resistance. The temperature of the cold junction 22 can be measured by means of a junction temperature sensor 28 which is accommodated in the zone 26 and which consequently has a good thermal coupling to the cold junction 22. The junction temperature sensor 28 comprises a resistor having a negative temperature coefficient (NTC resistor). Both the NTC resistor 28 and the thermocouple or the thermopile have electrical connection terminals (not shown) which have been led out. Infrared sensors of the type as shown in Figures 2 and 3 are commercially available.

The thermocouple in the infrared sensor 16 supplies a signal voltage which is proportional to the temperature difference between the hot junction 20 and the cold junction 22. Since the temperature of the cold junction is known from the resistance value of the NTC resistor 28, the temperature of the hot junction 20 can be determined on the basis of the signal voltage of the thermocouple or the thermopile. This determination is not very accurate because there is a substantial tolerance on the signal voltage when the hot junction is exposed to a given quantity of infrared radiation. According to the invention this tolerance in determining the temperature of the hot junction is avoided by heating the cold junction 22 so

far that the signal voltage of the thermocouple or the thermopile is substantially zero. Zero detection of an electric signal can be effected very accurately and by comparatively simple means. When the signal voltage of the thermocouple becomes zero this indicates that the temperature of the hot junction 20 is equal to the temperature of the cold junction 22. The temperature of the cold junction 22 can be measured in the customary manner by means of the NTC resistor 28. The cold junction 22 can be heated by means of a special heating element accommodated in the zone 26 of the infrared sensor 16 but it is alternatively possible to use external heating. Furthermore, the NTC resistor 28 can also be used as a means for heating the cold junction 22, which has the advantage that the response time is short as a result of the good thermal coupling between the NTC resistor 28 and the cold junction 22 and that use can be made of components which are present anyway. Yet another possibility is the use of the thermocouple or the thermopile itself as a heat source for heating the cold junction. The NTC resistor and the thermocouple or the thermopile then have a double function, which should be performed in different time intervals.

By heating the cold junction 22 until its temperature is equal to that of the hot junction 20 an arbitrary temperature of the hot junction 20 can be determined accurately. In thermal electrical appliances such as hair dryers it is often more important to know whether the object to be heated has reached a given temperature, for example 60 degrees Celsius for hair-drying. In such cases it is advantageous to heat the cold junction 22 to a given temperature which corresponds to the temperature of the hot junction under the desired operating conditions of the object to be heated. As soon as the object to be heated has reached the given temperature the temperature difference between the hot junction 20 and the cold junction 22 is zero and action can be taken, for example in the hair dryer described above, by reducing the heat supplied by the heating element 10 and/or by changing the speed of the fan 12 in order to preclude overheating of the hair 14 or burning of the scalp of the user.

Figure 4 is a circuit diagram of an electronic circuit in accordance with the inventive principles and suitable for use in thermometers or in thermal electrical appliances. The infrared sensor 16 is of a construction as shown in Figures 2 and 3. The NTC resistor 28 has terminals 30 and 32, which are connected to a circuit, not shown, which measures the resistance of the NTC resistor 28 and converts the measurement result into a temperature value, which is for example displayed on a display of a thermometer. The thermocouple or thermopile is shown as a voltage source 34 connected to a differential amplifier 40 via two terminals 36 and 38, which amplifier amplifies the signal voltage from

the thermocouple 34 to a suitable level. The cold junction of the infrared sensor 16 is heated by means of a heating element 42, which is arranged at a suitable location in the body of the infrared sensor 16. The heating element 42 is powered with a supply voltage Vcc via a switching transistor 44, which is turned on by a comparator 46, which compares the signal voltage from the thermocouple 34 with zero volt. The output of the comparator 46 is high as long as the hot junction is colder than the cold junction, in which case the switching transistor 44 is conductive and the heating element 42 is energized. When the cold and the warm junction are at the same temperature the signal voltage becomes zero and the output voltage of the comparator 46 changes over from a comparatively high voltage to a comparatively low voltage, as a result of which the switching transistor 44 is cut off. This situation persists until the temperature of the hot junction drops below that of the cold junction. Thus, a control circuit is obtained, which keeps the temperature difference between the hot junction and the cold junction of the infrared sensor substantially at zero. The temperatures of both junctions can be measured by means of the NTC resistor 28.

Figure 5 is a second circuit diagram of an electronic circuit in accordance with the inventive principles and suitable for use in thermal electrical appliances by means of which an object or a space is to be heated, such as hair dryers, fan heaters etc. The infrared sensor 16 and the differential amplifier 40 are identical to those of Figure 4. However, in the present circuit the temperature of the cold junction is brought to a given value by means of the heating element 42. For this purpose the switching transistor 44 is controlled by means of a comparator 48, which compares the instantaneous temperature of the cold junction with an adjustable reference temperature. The adjustable reference temperature is obtained by means of a variable voltage divider 50-52 which has its tap connected to the inverting input of the comparator 48. The instantaneous temperature is detected by means of a second voltage divider comprising a fixed resistor 54 and the NTC resistor 28. The comparator 48 keeps the switching transistor 44 in the conductive state and the heating element 42 is energized as long as the cold junction is colder than the adjusted temperature. As soon as the cold junction has reached the adjusted temperature the switching transistor 44 is cut off and the heating of the cold junction is turned off. The zero crossing of the output signal of the differential amplifier 40 indicates the instant at which the temperature of the hot junction has become equal to that of the cold junction and is consequently equal to the adjusted reference temperature.

Figure 6 shows a circuit whose operation is the same as that of Figure 5. However, the heating element 42 has been dispensed with and the NTC resistor 28 is now used for heating the cold junction. The NTC resistor 28 now has a double function, i.e. that

of cold junction temperature sensor and that of cold junction heating means. The NTC resistor 28 is connected between ground and the negative input of a comparator 56, which has its positive input connected to ground via an adjustable resistor 58. The negative input and the positive input of the comparator 56 are connected to a node 64 via respective resistors 60 and 62, which node is connected to a positive supply voltage Vcc via a resistor 66. A PNP switching transistor 68 is connected in parallel with the resistor 66, the base of this transistor being driven by the output of the comparator 56. As long as the resistance of the NTC resistor 28 is higher than that of the adjustable resistor 58 the voltage on the negative input of the comparator 56 is greater than that on the positive input and the output of the comparator 56 is comparatively low, as a result of which the PNP transistor 68 conducts and short-circuits the resistor 66. This results in a comparatively large current through the NTC resistor 28, the cold junction then being heated by the heat dissipation in the NTC resistor 28. As a result of the increasing temperature the resistance of the NTC resistor 28 decreases until the instant at which the resistance of the NTC resistor 28 becomes smaller than that of the adjustable resistor 58 and the output of the comparator 56 changes over to a comparatively high value, causing the PNP switching transistor to be cut off. Owing to the resistor 66 the current through the NTC resistor 28 is now comparatively small, as a result of which this resistor hardly dissipates so that the heating of the cold junction ceases.

Figure 7 shows a circuit whose operation is the same as that of Figure 4 or that of Figure 5 but in which the thermocouple or the thermopile 34 is used as a heating means for the cold junction. The temperature of the cold junction is measured by means of the NTC resistor 28, which is arranged in series with a resistor 70. The voltage variation across the NTC resistor 28 is measured by means of a first analog-to-digital converter (ADC) and is converted into a digital signal which is a measure of the temperature of the cold junction. The digital signal is processed in a microcontroller 74. The cold junction is heated by means of a current from a current source 76, which current flows through the internal resistance 80 of the thermopile 34 via a switch 78. The microcontroller 74 interrupts the current at regular instants to sample the amplified signal voltage of the thermopile on the output of the differential amplifier 40 via a second analog-to-digital converter 82 whose digital signal is also applied to the microcontroller 74. Any one of the measurement methods of Figures 4 and 5 can be carried out by suitably programming the microcontroller 74.

CLAIMS:

1. A device for measuring the temperature of an object (14), which device comprises: an infrared sensor (16), which infrared sensor comprises a thermocouple (34) having a first junction (20), which is exposed to infrared radiation emanating from the object (14) in operation, and a second junction (22), which is at a reference temperature in operation, and a junction temperature sensor (28) for measuring the temperature of the second junction (22), characterized in that the device further comprises: junction heating means (42) for heating the second junction (22) to a predetermined temperature.

2. A device as claimed in Claim 1, characterized in that the predetermined temperature is a temperature at which the thermocouple (34) generates an output signal which is substantially zero.

3. A device as claimed in Claim 1 or 2, characterized in that the junction heating means comprise a resistor (42) for heating the second junction (22) of the thermocouple (34).

4. A device as claimed in Claim 1 or 2, characterized in that the junction heating means comprise the thermocouple (34, 80) itself.

5. A device as claimed in Claim 1, 2, 3 or 4, characterized in that the junction temperature sensor is a temperature dependent resistor (28) which is thermally coupled to the second junction (22) of the thermocouple (34).

6. A device as claimed in Claim 1, 2 or 3, characterized in that the junction temperature sensor and the junction heating means comprise a temperature dependent resistor (28) which is thermally coupled to the second junction (22) of the thermocouple (34).

7. A thermal electrical appliance (2) comprising electric heating means (10) for heating an object (14), an infrared sensor (16) for measuring the temperature of the object (14), and control means (18) for controlling the heat output of the electric heating means (10) in response to a signal from the infrared sensor (16), the infrared sensor (16) comprising a thermocouple (34) having a first junction (20), which is exposed to infrared radiation emanating from the object (14) in operation, and a second junction (22), which is at a reference temperature in operation, and a junction temperature sensor (28) for measuring the temperature of the second junction (22), characterized in that the appliance (2) further

comprises: junction heating means (42, 28, 34) for heating the second junction (22) to a predetermined temperature.

8. A thermal electrical appliance as claimed in Claim 7, characterized in that the control means (18) comprise: a comparator (46, 48, 56, 74) for generating a control signal in response to a comparison of a signal from the junction temperature sensor (28) with a reference signal, and means (44, 68, 78) for activating the junction heating means (42, 28, 34) in response to the control signal.

9. A thermal electrical appliance as claimed in Claim 8, characterized in that the junction heating means and the junction temperature sensor are constructed by means of a common temperature dependent resistor (28) which is thermally coupled to the second junction (22) of the thermocouple (34).

10. A thermal electrical appliance as claimed in Claim 7, characterized in that the junction heating means comprise the thermocouple (34, 80) itself.

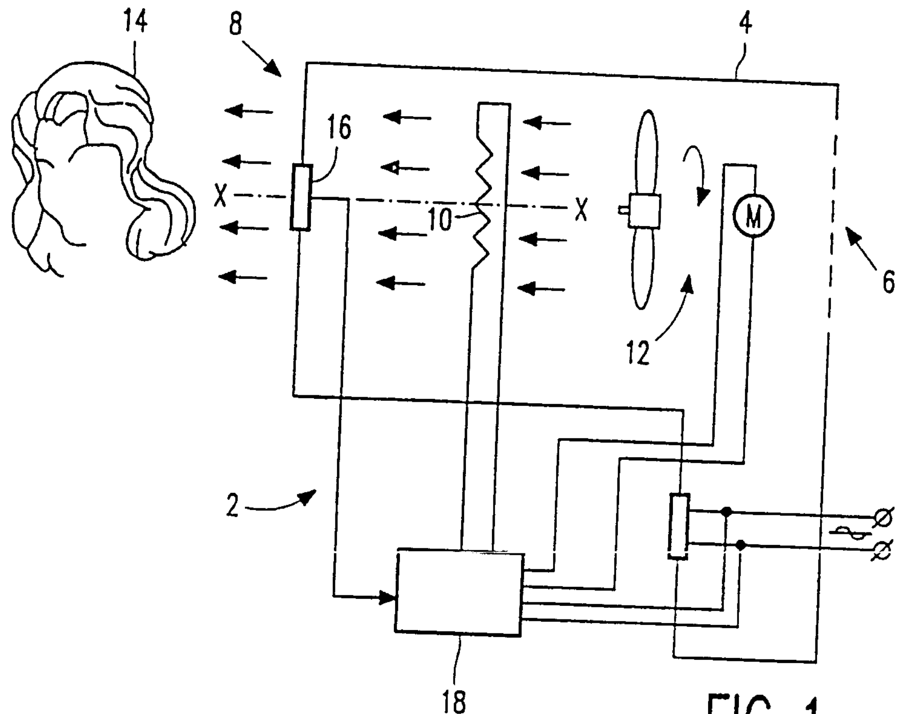


FIG. 1

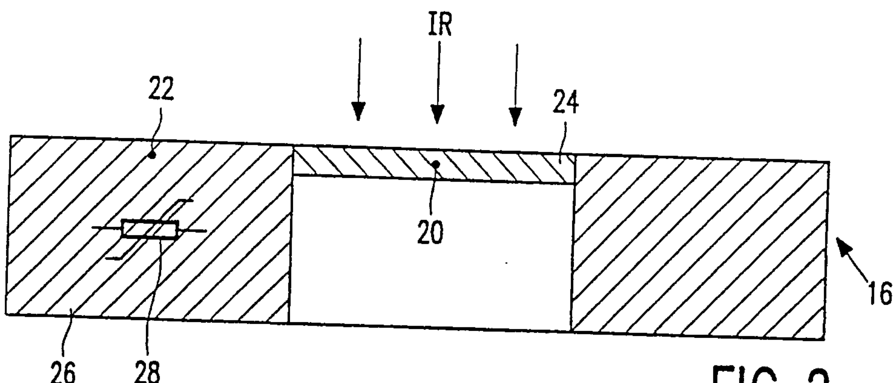


FIG. 2

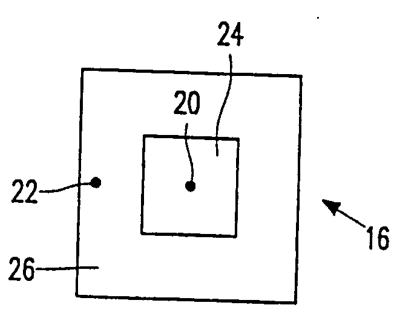


FIG. 3

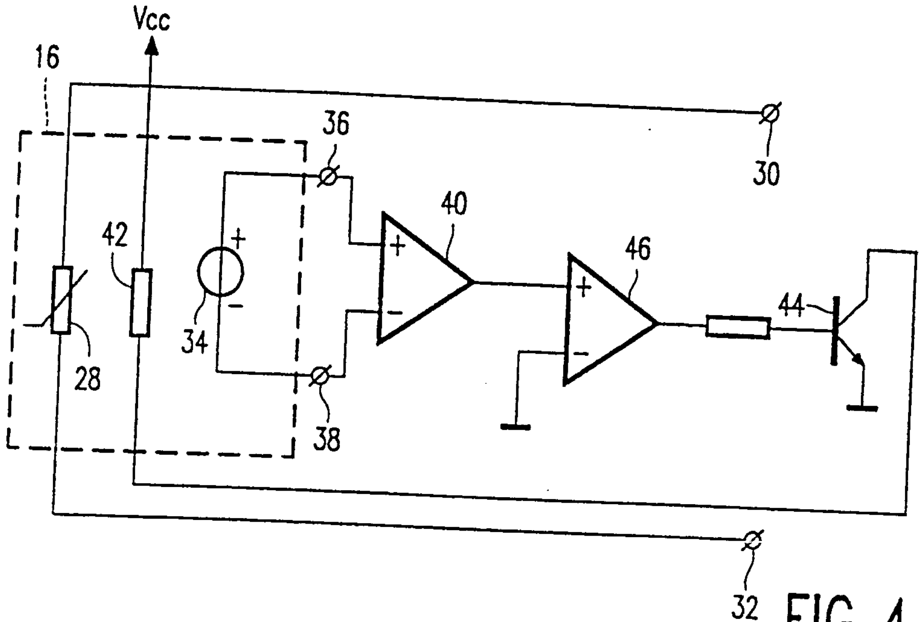

Vcc
16
36
30
40
42
46
34
44
28
38
32

FIG. 4

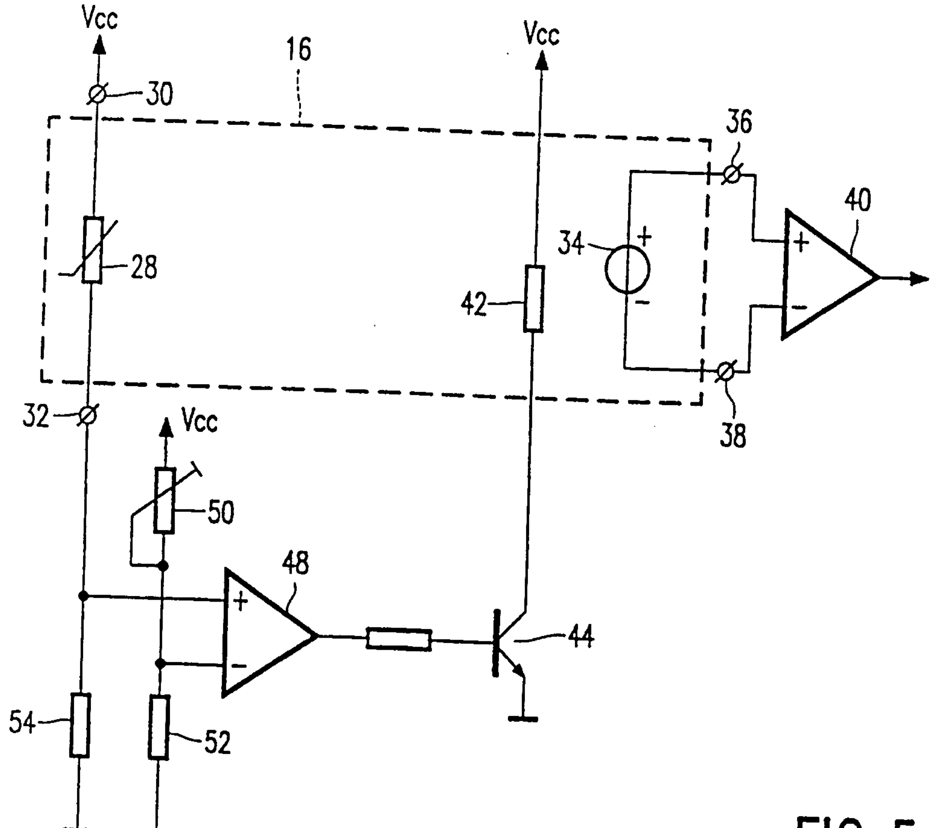

Vcc
16
Vcc
30
36
40
34
28
42
32
38
Vcc
50
48
44
54
52

FIG. 5

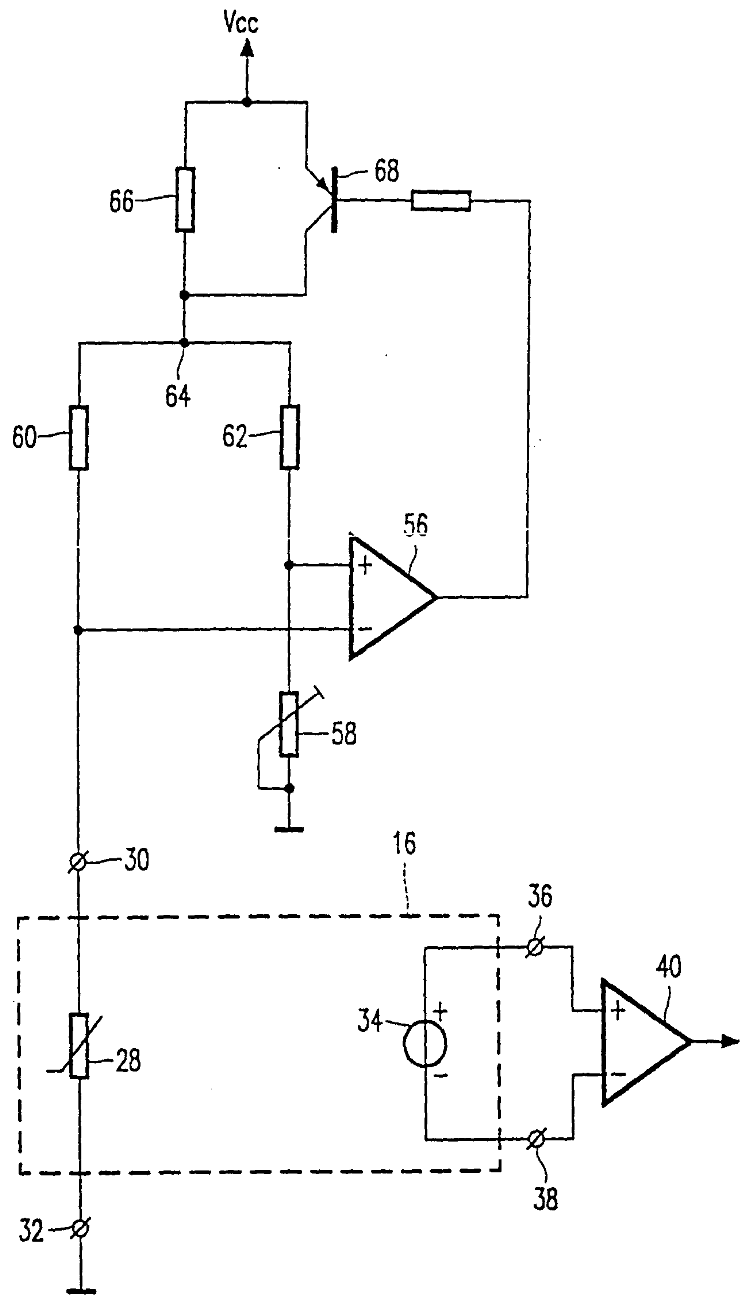


FIG. 6

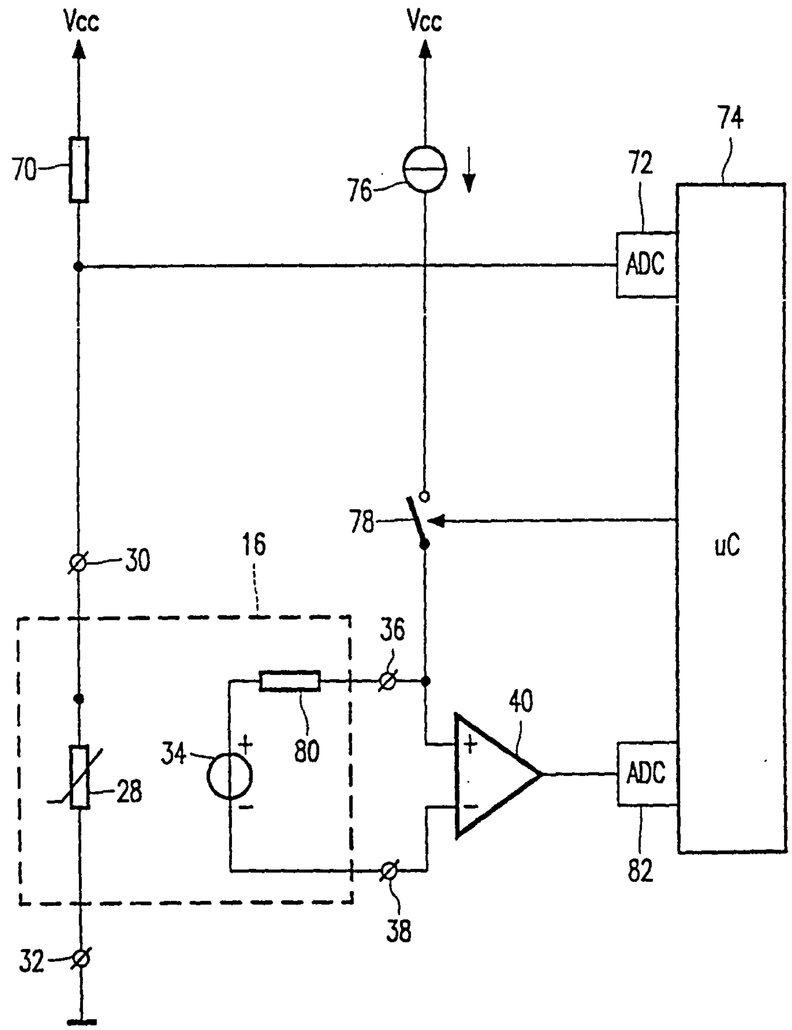


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 98/00759

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G01J 5/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0270299 A2 (THORN EMI PLC), 8 June 1988 (08.06.88), column 3, line 30 - column 4, line 11; column 5, line 12 - line 30, figures 1,6 --	1-10
X	US 4900162 A (K.A. BECKMAN ET AL.), 13 February 1990 (13.02.90), see the whole document --	1-10
X	US 5178464 A (J. FRADEN), 12 January 1993 (12.01.93), column 5, line 34 - line 40, figures 1, 2, abstract --	1-10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 December 1998	17 -12- 1998

Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Lars Jakobsson Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 98/00759

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4602642 A (G.J. O'HARA ET AL.), 29 July 1986 (29.07.86), column 7, line 52 - column 8, line 30 --	1-10
A	EP 0679350 A1 (LABORATOIRES D'ELECTRONIQUE PHILIPS), 2 November 1995 (02.11.95), figure 1, abstract --	1-10
A	GB 2093343 A (BRISTOL-MYERS COMPANY), 2 Sept 1982 (02.09.82), figure 1, abstract -- --------	1-10

INTERNATIONAL SEARCH REPORT
Information on patent family members

01/12/98

International application No.
PCT/IB 98/00759

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0270299 A2	08/06/88	US 4904090 A	27/02/90
US 4900162 A	13/02/90	CA 2012528 A,C	20/09/90
		DE 69017247 D,T	19/10/95
		EP 0391128 A,B	10/10/90
		JP 3028728 A	06/02/91
US 5178464 A	12/01/93	NONE	
US 4602642 A	29/07/86	CA 1272615 A	14/08/90
		EP 0180368 A,B	07/05/86
		HK 53695 A	21/04/95
		JP 61117422 A	04/06/86
		US 4662360 A	05/05/87
		US 4790324 A	13/12/88
		US 5179936 A	19/01/93
		US 5293862 A	15/03/94
		US 5516010 A	14/05/96
		US 5707343 A	13/01/98
EP 0679350 A1	02/11/95	JP 7289347 A	07/11/95
		SG 46131 A	20/02/98
		US 5790749 A	04/08/98
GB 2093343 A	02/09/82	DE 3206619 A,C	23/09/82
		IE 52561 B	09/12/87
		JP 57168605 A	18/10/82
		US 4424437 A	03/01/84